

**DEPARTMENT OF CONSUMER & INDUSTRY SERVICES
DIRECTOR'S OFFICE
OCCUPATIONAL HEALTH STANDARDS**

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(By authority conferred on the director of the department of consumer and industry services by sections 14 and 24 of 1974 PA 154 and Executive Reorganization Orders Nos. 1996-1 and 1996-2, MCL 408.1014, 408.1024, 330.3101, and 445.2001)

R 325.2401, R 325.2402, R 325.2403, R 325.2404, R 325.2405, R 325.2410, R 325.2411, R 325.2412, R 325.2413, R 325.2414, R 325.2415, R 325.2416, R 325.2417, R 325.2418, R 325.2419, R 325.2421, R 325.2422, R 325.2424, R 325.2429, R 325.2430, R 325.2431, R 325.2434, R 325.2435, R 325.2436, R 325.2437, R 325.2438, R 325.2439, R 325.2440, R 325.2441, R 325.2442, R 325.2442a, R 325.2442b, R 325.2442c, R 325.2443, R 325.2444, R 325.2445, R 325.2446, R 325.2447, and R 325.2448 of the Michigan Administrative Code are amended as follows:

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PART 700. AGRICULTURE

TABLE OF CONTENTS

	Page
R 325.2401 Scope.....	1
R 325.2402 General definitions.....	1
R 325.2403 Definitions pertaining to contaminants.....	2
R 325.2404 Definitions pertaining to noise.....	2
R 325.2405 Definitions pertaining to respirators.....	2
R 325.2410 Definitions pertaining to controls.....	2
R 325.2411 Contaminants; exposure; MACs.....	3
R 325.2412 Maximum allowable concentrations.....	3
R 325.2413 Maximum allowable concentrations for substances A and B.....	3
R 325.2414 Maximum allowable concentrations for substances C and D.....	3
R 325.2415 Maximum allowable concentrations for substances E to H.....	5
R 325.2416 Maximum allowable concentrations for substances I to M.....	5
R 325.2417 Maximum allowable concentrations for substances N to P.....	6
R 325.2418 Maximum allowable concentrations for substances Q to Z.....	7
R 325.2419 Maximum allowable concentrations for mineral dusts.....	8
R 325.2421 Continuous, broad-band noise.....	9
R 325.2422 Impulse noise.....	10
R 325.2424 Illumination.....	10
R 325.2429 Control methods for enclosures and controlled processes.....	10
R 325.2430 Rescinded.....	10
R 325.2431 Inert gas or foam systems.....	10
R 325.2434 Supply ventilation systems.....	10
R 325.2435 Direct-fired air heaters.....	11
R 325.2436 Exhaust ventilation systems.....	11
R 325.2437 Local exhaust ventilation.....	11
R 325.2438 General ventilation system.....	11
R 325.2439 Exhaust system discharge locations.....	11
R 325.2440 Recirculation of air from exhaust systems.....	11
R 325.2441 Air pollution control.....	11
R 325.2442 Respiratory protective equipment; selection and use.....	11
R 325.2442a Respiratory protective equipment; maintenance.....	12
R 325.2442b Respiratory protective equipment; types for certain hazards.....	12
R 325.2442c Respiratory protective equipment; supplies and components.....	12
R 325.2443 Variances.....	12
R 325.2444 Hearing procedures.....	12
R 325.2445 Emergency procedure.....	13
R 325.2446 Appeals.....	13
R 325.2447 Amendments; revisions.....	13
R 325.2448 Rescission.....	13

R 325.2401 Scope.

Rule 1. These rules apply only to places of employment.

R 325.2402 General definitions.

Rule 2. As used in these rules:

(a) **"Aerosol"** means particulate matter suspended in air.

(b) **"Contaminant"** means an airborne material capable of causing occupational disease or significant physiological disturbances to a person, and includes, but is not limited to, the substances listed in R 325.2413 to R 325.2419.

(c) **"Director"** means the director of the department of consumer and industry services or the designee of the director.

(d) **"Employer"** means an individual or type of organization which has in its employ 1 or more individuals performing services for it.

(e) **"Gas"** means a normally formless fluid which occupies a space or enclosure and which can be changed to the liquid or solid state by the effect of increased pressure or decreased temperature, or both.

(f) **"Inert gas"** means a gas or vapor which acts primarily as a simple asphyxiant without other significant physiological effect, recognizing that an inert gas may have flammable or explosive characteristics.

(g) **"Inert particulate"** means an aerosol which does not produce significant organic disease or toxic effect in a lung-tissue reaction from any of the following:

- (i) The architecture of the air spaces remains intact.
- (ii) Collagen (scar tissue) is not formed to a significant extent.
- (iii) The tissue reaction is potentially reversible.

(h) **"Particulate matter"** means fine solid or liquid particles.

(i) **"Physical agent"** means a form of energy transmitted directly or through the air from the point of emission to the receiver.

(j) **"Vapor"** means the gaseous state of a substance.

R 325.2403 Definitions pertaining to contaminants.

Rule 3. As used in these rules:

(a) **"Maximum allowable concentration"** or **"MAC"** means the threshold limit value or the time-weighted average 8-hour airborne concentration of a contaminant to which a person may be safely exposed. R 325.2413 to R 325.2419, tables 1 to 7, refer to the MAC of a particular contaminant.

(b) **"Mg/M³"** means milligrams of particulate per cubic meter of air.

(c) **"Mppcf"** means millions of particulates per cubic foot of air based on impinger samples counted by light field microscopic techniques.

(d) **"Non-respirable atmosphere"** means an atmosphere which contains insufficient oxygen, or an elevated level of contaminants, which may render a person incapable of self-rescue.

(e) **"Ppm"** means parts of vapor or gas per million parts of air by volume at 25 degrees Celsius and 760 millimeters of mercury pressure.

(f) **"Source"** means a process or equipment which releases a contaminant into the air in concentrations exceeding the MAC.

R 325.2404 Definitions pertaining to noise.

Rule 4. As used in these rules:

(a) **"Auditory protective equipment"** means ear plugs, muffs, or other protective devices worn by an exposed person to attenuate airborne noise pressure in the ear canal.

(b) **"Broad-band noise"** means noise generally distributed throughout the sound frequency spectrum.

(c) **"Continuous noise"** means an uninterrupted noise or more than 60 noises per minute.

(d) **"dBA"** means the airborne sound pressure level measured with the "A" weighting network of a sound level meter.

(e) **"Decibel"** or **"dB"** means a dimensionless unit expressing the ratio of 2 sound quantities in logarithmic form, 1 of which quantities is a reference level of 0.0002 microbar.

(f) **"Impact noise meter"** means an instrument used for the measurement of peak sound pressures of impulse.

(g) **"Impulse noise"** means a single noise or 60 or less noises per minute.

(h) **"Noise"** means airborne sound in the frequency range from 20 to 20,000 hertz or cycles per second.

(i) **"Sound level meter"** means an instrument, whose characteristics comply with those specified in the American standards association, standard S1.4-1961, used for the measurement of the airborne sound pressure level.

R 325.2405 Definitions pertaining to respirators.

Rule 5. As used in these rules:

(a) **"Atmosphere immediately dangerous to life or health"** means a nonrespirable atmosphere.

(b) **"Canister"** means a container filled with air-purifying media to remove gases and vapors from air drawn through the container. The canister may also contain an aerosol filter to remove solid or liquid particulate matter.

(c) **"Cartridge"** means a canister having reduced air-purifying capacity.

(d) **"Facepiece"** means that portion of a respirator that is designed to make a gastight or dusttight fit with the face and includes the headbands, exhalation valves, and connections for an air-purifying device or respirable-gas source. A half-mask facepiece covers the wearer's nose and mouth. A full-mask facepiece covers the wearer's nose, mouth, and eyes.

(e) **"Filter"** means a media used in a respirator to remove solid or liquid particulate matter from air drawn through the respirator.

(f) **"Respiratory protective equipment"** means a device or system designed to protect the wearer from inhalation of unhealthful atmospheres.

(g) **"Respirator"** means a type of respiratory protective equipment.

R 325.2410 Definitions pertaining to controls.

Rule 10. As used in these rules:

(a) **"Control"** means the limitation of worker exposure to contaminate levels not exceeding the MAC.

(b) **"Controlled process"** means an arrangement of equipment to control the contaminant by means of suitable design measures.

(c) **"Enclosure"** means a room, booth, or exhaust hood that confines contaminants at their sources.

(d) **"General ventilation"** means the supply and removal of air from a space to dilute or remove contaminants.

(e) "**Local exhaust ventilation system**" means an arrangement of exhaust hoods, ducts, and fans that removes air to control a contaminant at its source.

(f) "**Process space**" means a tunnel, process equipment, shaft, or enclosed space.

(g) "**Supply ventilation system**" means an arrangement of inlet openings or equipment to introduce outside air into the working environment.

R 325.2411 Contaminants; exposure; MACs.

Rule 11. (1) An employer shall not allow the exposure of a person to concentrations of a contaminant in excess of the limit expressed by the contaminant's MAC as established in R 325.2412 to R 325.2419.

(2) An employer shall not allow the exposure of a person to a contaminant or combination of contaminants in concentrations which are hazardous or injurious to the person's health.

R 325.2413 Maximum allowable concentrations for substances A and B.

Rule 13. Table 1 reads as follows:

Table 1

Substance	MAC	
	ppm	mg/m ³
Abate	---	15
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene	Inert gas	
Acetylene dichloride, see 1,2-Dichloroethylene		
Acetylene tetrabromide	1	14
Acrolein	0.1	0.25
S Acrylamide	---	0.3
S Acrylonitrile (see R 325.51501 et seq.*)		
S Aldrin	---	0.25
S Allyl alcohol	2	5
Allyl chloride	1	3
C Allyl glycidyl ether (AGE)	10	45
Allyl propyl disulfide	2	12
Alundum, (Al ₂ O ₃)	Inert dust	
2-Aminoethanol, see Ethanolamine		
2-Aminopyridine	0.5	2
Ammonia	50	35
Ammonium sulfamate (amate)	---	15
n-Amyl acetate	100	525
sec-Amyl acetate	125	650
S Aniline	5	19
S Anisidine (o,p-isomers)	---	0.5
Antimony & compounds (as Sb)	---	0.5
ANTU (alpha naphthyl thiourea)	---	0.3
Argon	Inert gas	
Arsenic, inorganic compounds	---	0.5
Arsenic, organic compounds (as As)	---	0.5
Arsine	0.05	0.2
S Azinphos-methyl	---	0.2
Barium (soluble compounds)	---	0.5

R 325.2412 Maximum allowable concentrations.

Rule 12. (1) Maximum allowable concentrations of air contaminants based on a repeated 8-hour work day exposure are in tables 1 to 7 in R 325.2413 to R 325.2419.

(2) A substance in tables 1 to 6 in R 325.2413 to R 325.2418, which is preceded by A, C, or S, is an especially hazardous contaminant and all of the following precautions shall be taken:

(a) If the substance is preceded by "A," then the employer shall not allow a person or any part of his or her anatomy to be exposed to or come in contact with the substance by any respiratory, oral, or skin route.

(b) If the substance is preceded by "C," then its MAC means the highest concentration at which an employer may allow a person to be exposed at any time.

(c) If the substance is preceded by "S," then an employer shall provide necessary precautions against skin absorption of the contaminant by a person.

Substance	MAC	
	ppm	mg/m ³
S,C Benzene (benzol) (see R 325.77101 et seq.*)		
A,S Benzidine	---	---
P-Benzoquinone, see Quinone		
Benzoyl peroxide	---	5
Benzyl chloride	1	5
Beryllium	---	0.002
Biphenyl, see Diphenyl		
Bisphenol A, see Diglycidyl ether		
Boron oxide	---	15
Boron tribromide	1	10
C Boron trifluoride	1	3
Bromine	0.1	0.7
Bromine pentafluoride	0.1	---
S Bromoform	0.5	5
Butadiene (1,3-butadiene) (see R 325.50091 et seq.*)		
Butanethiol, see Butyl mercaptan		
2-Butanone	200	590
S 2-Butoxy ethanol (butyl cellosolve)	50	240
Butyl acetate (n-butyl acetate)	150	710
sec-Butyl acetate	200	950
tert-Butyl acetate	200	950
Butyl alcohol	100	300
sec-Butyl alcohol	150	450
tert-Butyl alcohol	100	300
S,C Butylamine	5	15
S,C tert-Butyl chromate (as CrO ₃)	---	0.1
n-Butyl glycidyl ether (BGE)	50	270
Butyl mercaptan	0.5	1.5
p-tert-Butyltoluene	10	60

A, C, and S See R 325.2412.

*Caution--these rules contain extensive requirements for exposure to these substances.

R 325.2414 Maximum allowable concentrations for substances C and D.

Rule 14. Table 2 reads as follows:

Table 2

Substance	MAC		Substance	MAC	
	ppm	mg/m ³		ppm	mg/m ³
Cadmium (metal dust and soluble salts) (see R 325.51851 et seq.*)			Cyclohexane	300	1,050
C			Cyclohexanol	50	200
Cadmium oxide fume (as Cd) (see R 325.51851 et seq.*)			Cyclohexanone	50	200
Calcium arsenate	---	1	Cyclohexene	300	1,015
Calcium carbonate	Inert dust		Cyclopentadiene	75	200
Calcium oxide	---	5	2,4-D	---	10
Camphor (synthetic)	2	---	S DDT	---	1
Carbaryl (Sevin®)	---	5	(Dichlorodiphenyltrichloroethane)	---	
Carbon black	---	3.5	DDVP, see Dichlorvos		
Carbon dioxide	5,000	9,000	S Decaborane	0.05	0.3
S Carbon disulfide	20	60	S Demeton®	---	0.1
Carbon monoxide	50	55	Diacetone alcohol		
S,C Carbon tetrachloride	10	65	(4-hydroxy-4-methyl-2-pentanone)	50	240
Cellulose (paper fiber)	Inert dust		1,2-Diainoethane, see Ethylenediamine		
S Chlordane	---	0.5	Diazomethane	0.2	0.4
S Chlorinated camphene	---	0.5	Diborane	0.1	0.1
Chlorinated diphenyl oxide	---	0.5	S,C 2-Dibromoethane		
Chlorine	1	3	(ethylene dibromide)	25	190
Chlorine dioxide	0.1	0.3	Dibutyl phosphate	1	5
C Chlorine trifluoride	0.1	0.4	Dibutyl phthalate	---	5
C Chloroacetaldehyde	1	3	C Dichloroacetylene	0.1	0.4
alpha-Chloroacetophenone (phenacylchloride)	0.05	0.3	C o-Dichlorobenzene	50	300
Chlorobenzene			p-Dichlorobenzene	75	450
(monochlorobenzene)	75	350	Dichlorodifluoromethane	1,000	4,950
o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4	1,3-Dichloro-5,5-dimethyl hydantoin	---	0.2
Chlorobromomethane	200	1,050	1,1-Dichloroethane	100	400
2-Chloro-1,3-butadiene, see Chloroprene			1,2-Dichloroethane	50	200
S Chlorodiphenyl (42% Chlorine)	---	1	1,2-Dichloroethylene	200	790
S Chlorodiphenyl (54% Chlorine)	---	0.5	S,C Dichloroethyl ether	15	90
1-Chloro-2,3-epoxypropane, see Epichlorohydrin			Dichloromethane, see Methylene chloride		
2-Chloroethanol, see Ethylene chlorohydrin			Dichloromonofluoromethane	1,000	4,200
Chloroethylene, see Vinyl chloride			C 1,1-Dichloro-l-nitroethane	10	60
C Chloroform (trichloromethane)	50	240	1,2-Dichloropropane, see Propylene dichloride		
1-Chloro-1-nitropropane	20	100	Dichlorotetrafluoroethane	1,000	7,000
Chloropicrin	0.1	0.7	S Dichlorvos (DDVP)	---	1
S Chloroprene			S Dieldrin	---	0.25
(2-chloro-1,3-butadiene)	25	90	Diethyl	25	75
Chromic acid and chromates (as CrO ₃)	---	0.1	S Diethylamino, ethanol	10	50
Chromium, sol. chromic & chromous salts			S,C Diethylene triamine	10	42
(as Cr)	---	0.5	Diethyl ether, see Ethyl ether		
Metal & insol. salts	---	1	Difluorodibromomethane	100	860
Coal tar pitch volatiles (benzene soluble fraction: anthracene, BaP, phenanthrene, acridine, chrysene, pyrene)	---	0.2	C Diglycidyl ether (DGE)	0.5	2.8
Cobalt, metal fume & dust	---	0.1	Dihydroxybenzene, see Hydroquinone		
Coke oven emissions (see R 325.50101 et seq.*)			Diisobutyl ketone	50	290
Copper fume	---	0.1	S Diisopropylamine	5	20
Dusts and mists	---	1	Dimethoxymethane, see Methylal		
Corundum (Al ₂ O ₃)	Inert dust		S Dimethyl acetamide	10	35
Cotton dust (raw)	---	1	Dimethylamine	10	18
Crag® herbicide	---	15	Dimethylaminobenzene, see Xylidene		
S Cresol (all isomers)	5	22	S Dimethylaniline (N-dimethylaniline)	5	25
Crotonaldehyde	2	6	Dimethylbenzene, see Xylene		
S Cumene	50	245	Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate (Dibrom®)	---	3
S Cyanide (as CN)	---	5	S Dimethylformamide	10	30
Cyanogen	10	---	2,6-Dimethylheptanone, see Diisobutyl ketone		
			S 1,1-Dimethylhydrazine	0.5	1
			Dimethylphthalate	---	5
			S Dimethylsulfate	1	5
			S Dinitrobenzene (all isomers)	---	1
			S Dinitro-o-cresol	---	0.2

Substance	MAC	
	ppm	mg/m ³
S Dinitrotoluene	---	1.5
S Dioxane (diethylene dioxide)	100	360
Diphenyl	0.2	1
Diphenyl amine	---	10
Diphenylmethane diisocyanate, see Methylene bisphenyl isocyanate (MDI)		
S Dipropylene glycol methyl ether	100	600
Di-sec.octyl phthalate (di-2-ethylhexylphthalate)	---	5

A, C, and S See R 325.2412.

*Caution--these rules contain extensive requirements for exposure to these substances.

R 325.2415 Maximum allowable concentrations for substances E to H.

Rule 15. Table 3 reads as follows:

Table 3

Substance	MAC	
	ppm	mg/m ³
Emery	Inert dust	
S Endosulfan (Thiodan®)	---	0.1
S Endrin	---	0.1
S Epichlorohydrin	5	19
S EPN	---	0.5
1,2-Epoxypropane, see Propylene oxide		
2,3-Epoxy-1-propanol, see Glycidol		
Ethane	Inert gas	
Ethanethiol, see Ethyl mercaptan		
Ethanolamine	3	6
S 2-Ethoxyethanol	200	740
S 2-Ethoxyethylacetate (cellosolve acetate)	100	540
Ethyl acetate	400	1,400
S Ethyl acrylate	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
Ethyl mercaptan	0.5	1
Ethyl silicate	100	850
Ethylene	Inert gas	
S Ethylene chlorohydrin	5	16
Ethylenediamine	10	25
Ethylene dibromide, see 1,2-Dibromoethane		
Ethylene dichloride, see 1,2-Dichloroethane		
S,C Ethylene glycol dinitrate and/or Nitroglycerin	0.2	
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
S Ethyleneimine	0.5	1
Ethylene oxide (see R 325.51151 et seq.*)		
Ethylidene chloride, see 1,1-Dichloroethane		
S N-Ethylmorpholine	20	94
Ferbam	---	15

Substance	MAC	
	ppm	mg/m ³
Ferrovanadium dust	---	1
Fibrous glass	Inert dust	
Fluoride (as F)	---	2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
C Formaldehyde (see R 325.51451 et seq.*)		
Formic acid	5	9
S Furfural	5	20
Furfuryl alcohol	50	200
Gasoline (limits will be based on aromatic hydrocarbons in mixture)		
Glycerine mist	Inert mist	
Glycidol (2,3-epoxy-1-propanol)	50	150
Glycol monoethyl ether, see 2-Ethoxyethanol		
Graphite (synthetic)	Inert dust	
Guthion®, see Azinphos-methyl		
Gypsum	Inert dust	
Hafnium	---	0.5
Helium	Inert gas	
S Heptachlor	---	0.5
Heptane (n-heptane)	500	2,000
S Hexachloroethane	1	10
S Hexachloronaphthalene	---	0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone (methyl isobutyl ketone)	100	410
sec-Rexyl acetate	50	300
S Hydrazine	1	1.3
Hydrogen	Inert gas	
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
S Hydrogen cyanide	10	11
Hydrogen fluoride	3	2
Hydrogen peroxide	1	1.4
Hydrogen selenide	0.05	0.2
Hydrogen sulfide	10	15
Hydroquinone	---	2

A, C, and S See R 325.2412.

*Caution--these rules contain extensive requirements for exposure to these substances.

R 325.2416 Maximum allowable concentrations for substances I to M.

Rule 16. Table 4 reads as follows:

Table 4

Substance	MAC	
	ppm	mg/m ³
Indene	10	45
Indium and compounds (as In)	---	0.1
C Iodine	0.1	1
Iron oxide fume	---	10
Iron salts, soluble (as Fe)	---	1
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	950
Isopropyl alcohol	400	980
Isopropylamine	5	12

Substance	MAC	
	ppm	mg/m ³
Isopropyl ether	500	2,100
Isopropyl glycidyl ether (IGE)	50	240
Kaolin	Inert dust	
Ketene	0.5	0.9
Lead	---	0.2
Lead arsenate	---	0.15
Limestone	Inert dust	
S Lindane	---	0.5
Lithium hydride	---	0.025
L.P.G. (liquified petroleum gas)	1,000	1,800
Magnesite	Inert dust	
Magnesium oxide fume	---	15
S Malathion	---	15
Maleic anhydride	0.25	1
C Manganese and compounds (as Mn)---		5
Marble	Inert dust	
S Mercury	---	0.1
S Mercury (organic compounds)	---	0.01
Mesityl oxide	25	100
Methane	Inert gas	
Methanethiol, see Methyl mercaptan		
Methoxychlor	---	15
2-Methoxyethanol, see Methyl cellosolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
S Methyl acrylate	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol		
Methyl (n-amyl) ketone (2-heptanone)	100	465
S,C Methyl bromide	20	80
Methyl butyl ketone, see 2-Hexanone		
S Methyl cellosolve	25	80
S Methyl cellosolve acetate	25	120
C Methyl chloride	100	210
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
S o-Methylcyclohexanone	100	460
Methylenedianiline (MDA) (see R 325.51651 et seq.*)		
Methyl ethyl ketone (MEK), see 2-Butanone		
Methyl formate	100	250
S Methyl iodide	5	28
Methyl isoamyl ketone	100	475
S Methyl isobutyl carbinol	25	100
Methyl isobutyl ketone, see Hexone		
S Methyl isocyanate	0.02	0.05
Methyl mercaptan	0.5	1
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone		
C Methyl silicate	5	30
C alpha-Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2

Substance	MAC	
	ppm	mg/m ³
Methylene chloride (dichloromethane) (see R 325.51651 et seq.*)		
Molybdenum (soluble compounds) ---		5
(insoluble compounds) ---		15
S Monomethyl aniline	2	9
S,C Monomethyl hydrazine	0.2	0.35
S Morpholine	20	70

A, C, and S See R 325.2412.

*Caution--these rules contain extensive requirements for exposure to these substances.

R 325.2417 Maximum allowable concentrations for substances N to P.

Rule 17. Table 5 reads as follows:

Table 5

Substance	MAC	
	ppm	mg/m ³
Naphtha (coal tar)	100	400
Naphtha (petroleum)(MAC will be based on aromatic hydrocarbons in mixture)		
Naphthalene	10	50
A beta-Naphthylamine	---	
Neon	Inert gas	
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble compounds (as Ni)	---	1
S Nicotine	---	0.5
Nitric acid	2	5
Nitric oxide	25	30
S p-Nitroaniline	1	6
S Nitrobenzene	1	5
S p-Nitrochlorobenzene	---	1
Nitroethane	100	310
Nitrogen	Inert gas	
Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
S Nitroglycerin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
S,A N-Nitrosodimethylamine (dimethylnitrosamine)	---	---
S Nitrotoluene	5	30
Nitrotrichloromethane, see Chloropicrin		
Nitrous oxide	Inert gas	
S Octachloronaphthalene	---	0.1
Octane	400	1,900
Oil mist, particulate	---	5
Oil mist, vapor (MAC will be based on aromatic hydrocarbons in mixture)		
Osmium tetroxide	---	0.002
Oxalic acid	---	1
Oxygen difluoride	0.05	0.1
Ozone	0.1	0.2
S Paraquat	---	0.5
S Parathion	---	0.1
Pentaborane	0.005	0.01
S Pentachloronaphthalene	---	0.5
S Pentachlorophenol	---	0.5
Pentaerythritol	Inert particulate	

Substance	MAC	
	ppm	mg/m ³
Pentane	500	1,500
2-Pentanone	200	700
Perchloroethylene	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Petroleum distillates (naphtha)(MAC will be based on aromatic hydrocarbons in mixture)		
S Phenol	5	19
S p-Phenylene diamine	---	0.1
Phenyl ether (vapor)	1	7
Phenyl ether-biphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenyl glycidyl ether (PGE)	10	60
S Phenylhydrazine	5	22
S Phosdrin (Mevinphos®)	---	0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4
Phosphoric acid	---	1
Phosphorus (yellow)	---	0.1
Phosphorus pentachloride	---	1
Phosphorus pentasulfide	---	1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
S Picric acid	---	0.1
Pival® (2-pivalyl-1,3-indandione)	---	0.1
Plaster of Paris	Inert dust	
Platinum, soluble salts (as Pt)	---	0.002
Polytetrafluoroethylene decomposition products, see Teflon® decomposition products		
Propane	Inert gas	
S Propargyl alcohol	1	---
A beta-Propiolactone	---	---
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride	75	350
S Propylene imine	2	5
Propylene oxide	100	240
Propyne, see Methyl acetylene		
Pyrethrum	---	5
Pyridine	5	15

A, C, and S See R 325.2412.

R 325.2418 Maximum allowable concentrations for substances Q to Z.

Rule 18. Table 6 reads as follows:

Table 6

Substance	MAC	
	ppm	mg/m ³
Quinone	0.1	0.4
S RDX	---	1.5
Rhodium, metal fume, dusts, and insoluble compounds (as Rh)	---	0.1
Rhodium, soluble compounds (as Rh)	---	0.001
Ronnel	---	10
Rotenone (commercial)	---	5
Rouge	Inert dust	
Selenium compounds (as Se)	---	0.2

Substance	MAC	
	ppm	mg/m ³
Selenium hexafluoride	0.05	0.4
Silicon carbide	Inert dust	
Silver, metal and soluble compounds---		0.01
S Sodium fluoroacetate (1080)	---	0.05
Sodium hydroxide	---	2
Starch	Inert dust	
Stibine	0.1	0.5
Stoddard solvent	200	1,150
Strychnine	---	0.15
C Styrene monomer (phenylethylene)	100	420
Sucrose	Inert dust	
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	---	1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfuryl fluoride	5	20
Systox, see Demeton®		
2,4,5T	---	10
Tantalum	---	5
S TEDP	---	0.2
Teflon® decomposition products (maintain minimal air concentration)		
Tellurium	---	0.1
Tellurium hexafluoride	0.02	0.2
S TEPP	---	0.05
C Terphenyls	1	9
1,1,1,2-Tetrachloro-2,2-difluoroethane	500	4,170
1,1,2,2-Tetrachloro-1,2-difluoroethane	500	4,170
S 1,1,2,2-Tetrachloroethane	5	35
Tetrachloroethylene, see Perchloroethylene		
Tetrachloromethane, see Carbon tetrachloride		
S Tetrachloronaphthalene	---	2
S Tetraethyl lead (as Pb)	---	0.075
S Tetrahydrofuran	200	590
S Tetramethyl lead (THL) (as Pb)	---	0.150
S Tetramethyl succinonitrile	0.5	3
Tetranitromethane	1	8
S Tetryl		
(2,4,6-trinitrophenylmethyl)nitramine)---		1.5
S Thallium, soluble compounds (as T1)---		0.1
Thiram	---	5
Tin (inorganic compounds, except SnH ₄ and SnO ₂)	---	2
(organic compounds)	---	0.1
Tin oxide	Inert particulate	
Titanium dioxide	Inert particulate	
Toluene (toluol)	200	750
C Toluene-2,4-diisocyanate	0.02	0.14
S o-Toluidine	5	22
Toxaphene, see Chlorinated camphene		
Tributyl phosphate	---	5
1,1,1-Trichloroethane, see Methyl chloroform		
S 1,1,2-Trichloroethane	10	45
Trichloroethylene	100	535
Trichloromethane, see Chloroform		
S Trichloronaphthalene	---	5
1,2,3-Trichloropropane	50	300

Substance	MAC		Substance	MAC	
	ppm	mg/m ³		ppm	mg/m ³
1,1,2-Trichloro-1,2,2-trifluoroethane	1,000	7,600	Vinyl benzene, see Styrene		
Triethylamine	25	100	C Vinyl chloride (see R 325.51401 et seq. *)		
Trifluoromonobromomethane	1,000	6,100	Vinyl cyanide, see Acrylonitrile		
Trimethyl benzene	25	120	Vinyl toluene	100	480
2,4,6-Trinitrophenol, see Picric acid			Warfarin	---	0.1
2,4,6-Trinitrophenylmethylnitramine, see Tetryl			Xylene (xylol)	100	435
S Trinitrotoluene	---	1.5	S Xylidine	5	25
Triorthocresyl phosphate	---	0.1	Yttrium	---	1
Triphenyl phosphate	---	3	Zinc chloride fume	---	1
Tungsten and compounds (as W)			Zinc oxide fume	---	5
Insoluble	---	5	Zirconium compounds (as Zr)	---	5
Soluble	---	1	A, C, and S See R 325.2412.		
Turpentine	100	560	*Caution--these rules contain extensive requirements for exposure to these substances.		
Uranium (natural) soluble & insoluble compounds (as U)	---	0.2	R 325.2419 Maximum allowable concentrations for mineral dusts.		
C Vanadium (V ₂ O ₅ dust)	---	0.5	Rule 19. Table 7 reads as follows:		
(V ₂ O ₅ fume)	---	0.1			

Table 7
Mineral Dusts

SUBSTANCE	MAC (MPPCF)
Silica	
Crystalline *	
Quartz	MAC = $\frac{250}{\% \text{ SiO}_2 + 5}$
Cristobalite	MAC same as quartz
Amorphous, including natural diatomaceous earth	20
Silicates (less than 1% crystalline silica)	
Asbestos, all types (see asbestos in construction R 325.51301 et seq.)	
Mica	20
Portland cement	50
Soapstone	20
Talc (non-asbestiform)	20
Talc (fibrous) (see asbestos in construction R 325.51301 et seq.)	
Tremolite (see asbestos in construction R 325.51301 et seq.)	
Graphite (natural)	15
Inert or nuisance particles **	50 of total dust less than 1% SiO ₂ (or 15 mg/m ³ , whichever is the smaller)
* The percentage of crystalline silica, SiO ₂ , in the formula is the amount determined from airborne samples.	
** The following are some examples of inert or nuisance particulates when toxic impurities are not present; e.g. quartz less than 1%.	

Alundum (Al ₂ O ₃)	Corundum (Al ₂ O ₃)	Graphite (synthetic)	Magnesite	Plaster of Paris	Silicon carbide	Tin oxide
Calcium carbonate	Emery	Gypsum	Marble	Portland cement	Starch	Titanium dioxide
Cellulose	Glycerine mist	Limestone	Pentaerythritol	Rouge	Sucrose	Vegetable oil mists (except castor, cashew nut, or similar irritant oils)

R 325.2421 Continuous, broad-band noise.

Rule 21. (1) The following are maximum permissible levels of continuous, broad-band noise based on daily exposure time in places of employment:

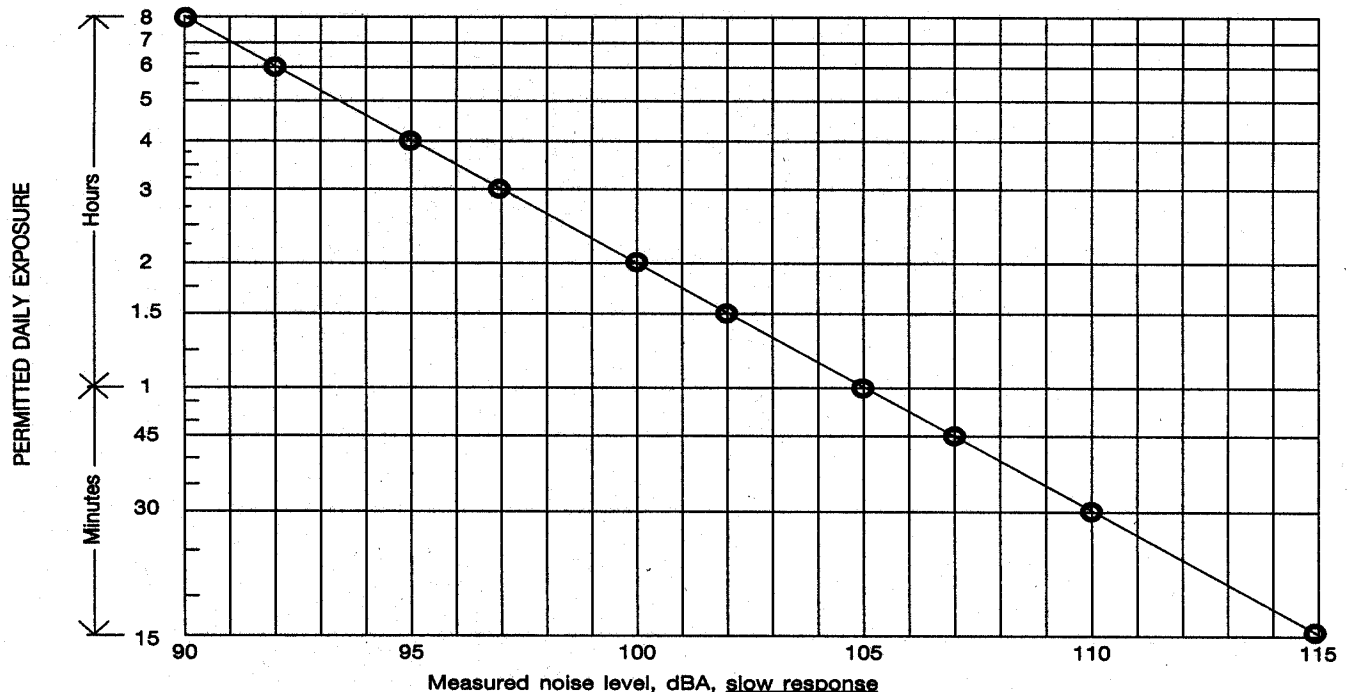
PERMITTED DAILY EXPOSURE TIME, HOURS	MAXIMUM PERMISSIBLE NOISE LEVEL, DBA, SLOW RESPONSE
8	90
6	92
4	95
3	97

2	100
1 1/2	102
1	105
3/4	107
1/2	110
1/4	115

(2) If a noise level is between 2 listed maximum permissible noise levels in subrule (1) of this rule, then chart A shall be used to determine the permitted daily exposure time. In applying the chart, measured noise levels will be taken to the nearest whole number.

Chart A

NOISE EXPOSURE CHART



(3) If airborne noise levels and exposure times exceed the values in subrule (1) or (2) of this rule, then noise control measures or reduction of exposure time shall be provided or auditory protective equipment shall be provided by the employer and used by the employee.

(4) If the daily noise exposure is composed of 2 or more periods of noise exposure of different levels, each period of noise exposure shall be determined by dividing the actual exposure time in minutes at the

measured noise level by the permitted exposure time in minutes at that measured noise level pursuant to subrule (1) of this rule. The noise exposure for the periods shall be totaled. The total noise exposure shall not exceed the unit number 1.

If an actual exposure time is measured at a noise level less than 90 dBA, then that period of noise exposure shall be unlimited or infinity (∞).

(5) The following are examples of the use of the formula in accordance with subrule (4) of this rule:

$$N = \frac{t_1}{T_1} + \frac{t_2}{T_2} + \frac{t_3}{T_3} + \dots$$

N = total noise exposure.
 t_1, t_2, t_3 = actual exposure times in minutes, at different noise levels.
 T_1, T_2, T_3 = permitted exposure times in minutes, at different noise levels.

Example #1

5 Hr. = 300 Min. Exposure @ 83 dBA Permissible Time = ∞
 2 Hr. = 120 Min. Exposure @ 95 dBA Permissible Time = 4 Hr. = 240 Min.
 1 Hr. = 60 Min. Exposure @ 97 dBA Permissible Time = 3 Hr. = 180 Min.
 $\frac{t_1}{T_1} + \frac{t_2}{T_2} + \frac{t_3}{T_3} = N: \frac{300}{\infty} + \frac{120}{240} + \frac{60}{180} = 0 + .5 + .33 = .83$
 Since N does not exceed 1 the exposure is less than the permissible limit.

Example #2

1 Hr. = 60 Min. Exposure @ 87 dBA Permissible Time = ∞
 3 Hr. = 180 Min. Exposure @ 90 dBA Permissible Time = 8 Hr. = 480 Min.
 3 Hr. = 180 Min. Exposure @ 95 dBA Permissible Time = 4 Hr. = 240 Min.
 1 Hr. = 60 Min. Exposure @ 100 dBA Permissible Time = 2 Hr. = 120 Min.
 $\frac{t_1}{T_1} + \frac{t_2}{T_2} + \frac{t_3}{T_3} = N: \frac{60}{\infty} + \frac{180}{480} + \frac{180}{240} + \frac{60}{120} = 0 + .38 + .75 + .5 = 1.63$
 Since N is greater than 1 the exposure exceeds the permissible limit.

(6) A sound level meter shall be used with the "A" network, slow response to compare airborne continuous noise levels with the maximum permissible noise levels.

R 325.2422 Impulse noise.

Rule 22. The maximum permissible level for impulse noise shall be 140 dB as measured with a cathode-ray oscilloscope system or with other equipment such as the impact noise meter capable of indicating the maximum-instantaneous peak noise level.

R 325.2424 Illumination.

Rule 24. The level of illumination shall be adequate as determined by the director for the performance of the task.

R 325.2429 Control methods for enclosures and controlled processes.

Rule 29. (1) An enclosure shall be provided at a stationary source unless the omission of the enclosure does not impair control.

(2) A controlled process shall be designed and regulated to prevent the creation of a hazard to health or life. If the director determines that there may be an immediate danger to health or life due to the failure of the process design or regulatory device, then he or she may require that the process fail-safe in such manner to avert the hazard.

R 325.2430 Rescinded.

R 325.2431 Inert gas or foam systems.

Rule 31. If an inert gas or foam system is provided in an occupied area for the prevention or extinguishment of fire or explosion, then the affected area shall be conspicuously posted to call attention to the potential creation of a nonrespirable atmosphere. The actuating of an audible and visible alarm before the system is activated shall be provided. The system shall incorporate a sufficient time-delay to permit the egress of persons within the affected area. After the activation of the system, an audible and visible warning that a nonrespirable atmosphere has been created within the area shall continue until the nonrespirable atmosphere has been purged or diluted with air to safe breathing levels.

R 325.2434 Supply ventilation systems.

Rule 34. (1) A supply ventilation system shall be provided to ensure a flow of air into the working environment to replace the volume of air exhausted.

(2) A mechanical air supply system shall be provided if its absence will result in building negative pressures sufficient to cause back-drafting of vents from fuel-fired equipment or ineffective control.

(3) Mechanical air supply volumes shall be heated to maintain a minimum air temperature of 65 degrees Fahrenheit measured at the point of air discharge to the space. Exceptions to this requirement are refrigerated storage rooms, special process rooms, and similar locations where lower air temperatures are essential to the preservation of the product or service, or, if in the opinion of the director, a lower air temperature will not be harmful to the health of the persons affected.

R 325.2435 Direct-fired air heaters.

Rule 35. (1) A direct-fired air heater, wherein combustion products are released in the supply air stream, may be installed in buildings of industrial occupancy, garages, laundries, and commercial kitchens. They shall not be installed in offices, schools, hospitals, and places of public assembly.

(2) A direct-fired air heater shall have an inlet duct connected directly to the out-of-doors. Room air shall not be circulated across the burner.

(3) A direct-fired air heater shall deliver air which contains not more than 10 ppm of carbon monoxide and is free from odors of combustion products. Permissible concentrations of other contaminants in the delivered air may be established by the director pursuant to their MAC and the degree of exposure to a person.

(4) The air volume supplied to the building by a direct-fired air heater shall not exceed 110% of the total air volume exhausted. The director may require interlocking of a heater control system with an exhaust ventilation system if necessary to ensure that the exhaust systems are operating.

(5) A direct-fired air heater shall have both of the following:

- (a) A pre-ignition purge of fresh air.
- (b) A positive fuel supply closure in the event of fuel supply failure, ignition failure, flame failure, power failure or interruption, or air flow reduction below 50% of its rated capacity.

R 325.2436 Exhaust ventilation systems.

Rule 36. The minimum rate of exhaust ventilation for places of manufacturing, processing, assembling, maintenance and repair, or storage of material shall be 1 cubic foot of air per minute per square foot of floor area. This amount of exhaust ventilation may be provided by local exhaust, general exhaust, or both. The director may permit a variance if contaminant control can be accomplished at a lesser rate of ventilation.

R 325.2437 Local exhaust ventilation.

Rule 37. (1) Local exhaust ventilation shall be provided at all stationary sources. The director may allow a variance from this requirement if control is accomplished with general ventilation.

(2) If a local exhaust system is used, then the exhaust air volume shall create an indraft air volume at an enclosure, hood, duct, or fan sufficient to control the contaminant.

(3) A local exhaust system shall be designed to capture and control the contaminant. Distribution of exhaust air between various exhaust points may be accomplished by balanced duct design. If balancing gates are used, then they shall be locked permanently in place after final adjustment.

(4) The design and construction of a local exhaust ventilation system shall be adequate for the contaminant and conditions of service. A listing of practical ventilation texts and references shall be available from the director upon request. Technical

information and experience regarding specific contaminants and control measures may be obtained from the director.

R 325.2438 General ventilation system.

Rule 38. A general ventilation system may be used for contaminant control. The ventilation air volume shall be sufficient to dilute the airborne contaminant to levels not exceeding the MAC.

R 325.2439 Exhaust system discharge locations.

Rule 39. The discharge locations of local exhaust or general exhaust systems shall not permit exhausted air to re-enter a workroom or other buildings directly, or indirectly, through air supply systems without substantial dilution.

R 325.2440 Recirculation of air from exhaust systems.

Rule 40. (1) The recirculation of air containing a contaminant whose MAC is at least 1000 ppm, 15 mg/m³, or 50 mppcf, shall be permitted if the exhaust ventilation system is equipped with an air cleaning device capable of reducing the contaminant concentrations to 10% or less of their MAC in the returned air.

(2) The director may allow the recirculation of air containing a contaminant whose MAC is less than 1000 ppm, 15 mg/m³ or 50 mppcf, if the toxicity of the contaminant and the degree of air cleaning to be achieved create an environment which will not impair the health of the workers, and if the contaminant concentrations in the returned air do not exceed 10% of its MAC.

(3) A recirculation system shall include an alternate air duct connection to discharge the returned air outside of the building if necessary to protect the workers' health.

R 325.2441 Air pollution control.

Rule 41. A local exhaust and general exhaust ventilation system shall comply with rules adopted by the Michigan Department of Environmental Quality, being R 336.1101 to R 336.1910.

R 325.2442 Respiratory protective equipment; selection and use.

Rule 42. (1) Respiratory protective equipment for the safeguarding of the workers' health shall be provided by the employer if other methods do not control the contaminants.

(2) Respiratory protective equipment for the safeguarding of a worker's health may be used in place of other control measures in intermittent or temporary work situations.

(3) Respiratory protective equipment shall be of a type approved for protection against the contaminant and degree of exposure to be encountered. A listing of approved types of respiratory protective equipment shall be available from the director.

(4) Responsibility for equipment selection, issuance, use, training, and maintenance shall be vested in a

qualified individual who shall have sufficient knowledge of the subject.

(5) A worker shall be trained in the use of the equipment and shall have an opportunity to become familiar with it, have it fitted properly, and test its facepiece to face seal. If a worker needs to wear corrective lenses, then the facepiece and lenses shall be fitted by a qualified individual.

(6) A worker shall use the equipment in accordance with instructions, shall report any malfunctioning of the equipment to the person responsible, and shall guard the equipment against damage.

(7) If the equipment is to be used in an atmosphere immediately dangerous to life or health, then the worker shall use it in normal air for a reasonable familiarity period.

(8) Emergency equipment shall be readily accessible at all times and its location shall be clearly marked.

R 325.2442a Respiratory protective equipment; maintenance.

Rule 42a. (1) Respiratory protective equipment shall be maintained in clean and effective condition.

(2) Routinely used equipment shall be cleaned, inspected, and sanitized as frequently as necessary to ensure that proper protection is provided for the wearer.

(3) Emergency equipment that is not routinely used shall be inspected, cleaned, and sanitized after each use and inspected at least monthly to ensure that it is in effective working condition. A record shall be kept of inspection dates and findings.

(4) Equipment inspection shall include a check of the tightness of connections and the proper functioning of all parts.

(5) Replacement or repairs shall be made by trained persons with parts designated for the specific equipment. Reducing valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair.

(6) Equipment shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals.

R 325.2442b Respiratory protective equipment; types for certain hazards.

Rule 42b. The following equipment shall be used in any of the following hazards:

HAZARD	REQUIRED EQUIPMENT
Oxygen deficiency	Hose mask with blower Self-contained breathing apparatus
Gas vapor, particulate contaminants Atmospheres immediately dangerous to life or health Atmospheres not immediately dangerous to life or health	Hose mask with blower Self-contained breathing apparatus Self-rescue mouthpiece respirator (for escape only) Air-line respirator Air-line abrasive blasting respirator (for escape only) Gas mask with canister or with canister and filter Hose mask with blower Respirator with chemical cartridge or filter or both

R 325.2442c Respiratory protective equipment; supplies and components.

Rule 42c. (1) Compressed or liquid oxygen used with respiratory protective equipment shall be of high purity. Compressed oxygen shall not be used in supplied-air respirators or in open-circuit self-contained breathing apparatus that have previously used compressed air.

(2) Air may be supplied to equipment from cylinders or air compressors with proper pressure regulation and control. Air shall contain 19-23% oxygen and not more than 20 ppm carbon monoxide and 5 mg/m³ oil mist.

(3) A compressor or compressor air intake shall be situated so as to prevent entry of contaminants into the system in amounts which may be injurious to the health of an exposed person.

(4) An oil lubricated compressor shall incorporate suitable inline air purifying sorbents and filters, temperature regulators, and high-temperature cut-off to assure breathing air quality. An oil lubricated compressor shall not use vegetable oil lubricants.

(5) An air-line coupling or connector shall be incompatible with outlets for other gas systems to

prevent connection with nonrespirable gases or oxygen.

(6) A self-contained breathing apparatus and universal type gas mask shall incorporate an audible or visible alarm or window to indicate impending failure of the device to provide respirable air. It is recommended that warning be given when 20-25% of rated service time remains.

R 325.2443 Variances.

Rule 43. Variances as provided in R 325.2436 and R 325.2437(1) may be granted by the director upon written request. Variances granted by the director shall be in writing and shall consider the potential health hazard and the control measures to be employed.

R 325.2444 Hearing procedures.

Rule 44. (1) The director shall serve a written notice upon an employer alleged to be in violation of these rules. The notice shall describe the alleged violation and set a date, time, and place for a hearing to determine whether a violation exists. The notice

shall be delivered at least 15 days before the hearing date.

(2) Evidence and testimony may be introduced at the hearing and all interested parties shall be given the full opportunity to present evidence and to cross-examine witnesses.

(3) If a violation is found to exist, the director shall issue an order directing the person, firm, or corporation to correct the violation before a specified correction date. The correction date shall be established with consideration to the health hazard involved and the difficulty of eliminating the violation.

(4) At the time of the hearing, or within 30 days after receipt of an order from the director, the person, firm, or corporation may request an extension of the correction date. The director may grant an extension of the correction date, with consideration to the health hazard and the difficulty of correction, for a reasonable time if it is shown that the violation can and will be corrected before the extended correction date.

(5) If a violation is not eliminated within the time specified, then the director shall issue a final order directing the person, firm, or corporation to cease the operation of the source that is in violation.

R 325.2445 Emergency procedure.

Rule 45. If the director knows there is an immediate and serious hazard from exposure to a contaminant and he or she believes that a delay of 15 days would be prejudicial to the health or life of exposed persons, then the director shall notify the employer by written notice to discontinue immediately the exposure to the contaminant. Within 15 days the director shall provide the employer the opportunity to be heard and to present any proof that exposure to the contaminant does not constitute a danger to the health or life of the exposed persons.

R 325.2446 Appeals.

Rule 46. An employer aggrieved by a decision of the director may appeal the decision pursuant to sections 101 to 106 of 1969 PA 306, MCL 24.301 to 24.306.

R 325.2447 Amendments; revisions.

Rule 47. (1) If the director has knowledge that rule revision is required for the prevention of occupational disease or significant physiological disturbance, or after consideration of a request by any person, he may proceed to amend these rules in accordance with the administrative procedures act.

(2) If the director believes that there is a significant hazard to the health of exposed persons, he may proceed to amend these rules and provide for the immediate effect of the amendment in accordance with the administrative procedures act.

R 325.2448 Rescission.

Rule 48. The rules entitled "Basic Guides for Control of Exposure to Atmospheric Contaminants in Places of Employment," being R 325.1351 to R 325.1355 of the Michigan Administrative Code and appearing on pages 2592 to 2599 of the 1962 Annual Supplement to the Code, are rescinded.